REMARKS/ARGUMENTS

The Examiner is thanked for the thorough examination and search of the subject.

Claims 4, 5, 7, 8, 13, 14, 16, 17, 22 and 23 remain canceled.

All Claims are believed to be in condition for Allowance, and that is so requested.

Reconsideration of Claims 1-3, and 6 rejected under 35 USC 103(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), Ye et al (U.S. 6,080,529), Huang et al (U.S. 6,180,509, B1) and Liu et al (U.S. 5,693,568) is requested based on Amended Claim 1 and on the following remarks.

Applicant agrees that the cited art teach methods to form interconnects. However, Applicant does not believe that the cited art, individually or in combination, teach, suggest, or hint at the method of Applicant's claim invention. In particular, Applicant teaches forming self-aligned, anti-via interconnects using a method wherein a tantalum-containing etch stop layer 62 is used as an etching stop between the first metal layer 58 and second metal layer 66. More particularly, this tantalum-containing etch stop layer 62 specifically prevents etching of the first metal layer 58 during the etching of the second metal layer 66 to form vias. Applicant's claimed invention, as recited in Amended Claim 1, makes clear that the etching stop is specifically used to prevent etching of the underlying first metal layer during the etching through of the

second metal layer to create vias. This feature is especially distinct from Ye et al wherein a tantlum nitride barrier layer 218 is used, in one instance, to prevent a process used to etch a fluorine-containing layer 220 from etching an underlying metal layer 216. Ye contains no teaching or suggestion to employ a tantalum-containing layer as an etch stop for a metal etching process.

Applicant has amended Claim 1 to make this distinction more clear. In particular, Amended Claim 1 now reads:

1. (Currently Amended) A method of forming self-aligned, anti-via interconnects in an integrated circuit device comprising:

providing a semiconductor substrate;

depositing a first metal layer overlying said semiconductor substrate;

depositing an etch stop layer overlying said first metal layer wherein said etch stop layer comprises a tantalum containing film;

depositing a second metal layer overlying said etch stop layer;

depositing an anti-reflective coating layer comprising titanium nitride overlying said second metal layer;

etching through said second metal layer, said etch stop layer, and said first metal layer to form connective lines;

thereafter etching through said second metal layer to form vias wherein said etch stop layer prevents ~~acts as an etch stop for~~ etching ~~through~~ of said first ~~second~~ metal layer;

15 thereafter depositing a dielectric layer overlying said vias, said connective lines and said semiconductor substrate; and

polishing down said dielectric layer to complete said self-aligned, anti-via interconnects in the manufacture of the integrated circuit device.

Claims 9 and 18 have been similarly amended. Lines 12-14 of Claim 1 make clear that the tantalum-containing etch stop layer specifically acts to prevent etching of the first metal layer during the etching through of the second metal layer to form vias.

Applicant notes that the cited art of Rhodes et al, Huang et al, Lie et al, and Wang et al do not appear to teach, suggest, or hint at, separately or in combination, the application of a tantalum-containing layer to prevent etching of a protected first metal layer during the etch of a non-protected second metal layer. In addition, Applicant has carefully reviewed Ye et al (U.S. Patent 4,536,951). Ye et al does describe tantalum nitride barrier layers 214 and 218 that underlie and overlie a conductive copper layer 216 in Figs. 2A-2G. In addition, in Figs. 3A-3G, tantalum nitride barrier layers 314 and 318 underlie and overlie a conductive copper layer 316. Each of these examples differ substantially from the present invention because Ye et al does not teach, suggest a method for using these layers as an etching stop for a metal layer etch.

In regards to Figs. 2A-2G, Ye et al first states:

"FIG. 2E shows the plasma etching stack after transfer of the pattern

through tantalum nitride barrier layer 218, copper layer 216, and tantalum nitride barrier layer 214 to the upper surface of silicon dioxide dielectric layer 212. (column 12, lines 63-64)"

Note that Fig. 2E shows the etching step removing all three layers 218, 216, and 214 down to the silicon dioxide 212. In this case, the lower tantalum nitride layer 214 is clearly not used as an etching stop during the etch of the metal layer 216 since the etching process is described and illustrated as transferring *through* all three layers.

Similarly, with reference to Figs. 3A-3G, Ye et al states:

"FIG. 3E shows the transfer of the pattern through tantalum nitride barrier layer 318, copper layer 316, and tantalum nitride barrier layer 314 to the upper surface of silicon dioxide dielectric layer 312. (column 15, lines 19-22)"

Fig. 3E shows the etching step removing the top two layers 218 and 216 while layer 214 remains. However, this appears to be an error because (1) it is not consistent with the text and (2) the text provides no indication that the lower tantalum nitride barrier layer 214 is used in anyway as an etching stop for the metal layer 216 etch.

Ye et al does describe the tantalum nitride barrier layer 218 of Figs. 2A-2G as an etch stop in the following citation:

> "The underlying layer 222 of silicon dioxide was used as an etch stop over high-temperature organic-based layer 220, while tantalum nitride barrier layer 218 was used as the etch stop protecting copper layer 216 from oxidation." (column 12, lines 40-43)

This citation is describing the protection of the copper layer 216 from the effects of the oxygen-based plasma used to remove the α-FC layer 220. There is no indication in Ye et al that such an approach would be useful to protect the copper layer 216 during an etching process having process chemistry useful for metal etching. Ye et al do not teach, suggest, or hint at this feature. Further, the cited art of Rhodes et al, Ye et al, Huang et al, Lie et al, and Wang et do not appear to teach, suggest, or hint at, separately or in combination, this feature. Only Applicant's claimed invention teaches this feature.

Applicant clearly teaches in the Specification, page 12,

> ". . . the etch stop layer 62 stops the etching process from attacking the underlying first metal layer 58. In this way, the second metal layer 66 is completely etched through without etching the first metal layer 58."

This feature is illustrated in Fig. 6 of the Drawings. Furthermore, Applicant has amended Claim 1 to make clear this distinctive feature of Applicant's claimed invention.

In light of the above, Applicant believes that the cited art, separately or in combination, do not teach or suggest a key feature of the claimed invention such that one skilled in the art at the time of the invention could have practiced the invention. In particular, the cited art do not teach or suggest using a tantalum-containing etching stop to stop a metal layer etch as is taught in Applicant's claimed invention. Therefore, Applicant requests that Claim 1 not be rejected under 35 USC 103(a). Further, Claims 2-3 and 6 represent patentably distinct, further limitations on Claim 1 that Applicant requests not be rejected under 35 USC 103(a).

Reconsideration of Claims 1-3, and 6 rejected under 35 USC 102(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), Ye et al (U.S. 6,080,529), Huang et al (U.S. 6,180,509, B1) and Liu et al (U.S. 5,693,568) is requested based on Amended Claim 1 and on the above remarks.

Reconsideration of Claims 9-12, 15 and 18-21 rejected under 35 USC 102(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), Ye et al (U.S. 6,080,529), Huang et al (U.S. 6,180,509, B1) and Liu et al (U.S. 5,693,568) and Pangrie et al (U.S. 6,713,382 B1) is requested based on Amended Claims 9 and 18, and on the following remarks.

As described above, Applicant has amended Claims 9 and 18 in similar fashion as Amended Claim 1. As discussed above, the cited art of Rhodes et al, Ye et al, Huang

et al, and Liu et al, do not teach or suggest, separately of in combination, the limitation added to Claim 9 by amendment. In addition, while Pangrle et al do mention using tantalum nitride as a barrier layer (column 9, lines 30-33), the reference does not teach or suggest using this tantalum nitride as an etching stop for etching through a top metal layer while not etching a lower metal layer as is taught in the claimed invention. Therefore, Applicant requests that Amended Claim 9 not be rejected under 35 USC 103(a). Further, Claims 10-12 and 15 represent patentable further limitations on Amended Claim 9 that Applicant requests not be rejected under 35 U.S.C. 103(a) if Claim 9 is not rejected. In addition, Claim 18 maintains the key limitations of an etching stop comprising a tantalum containing film wherein this film is used as an etching stop for the via metal etch. Therefore, Applicant requests that Claim 18 not be rejected under 35 USC 103(a). Further, Claims 19-21 represent patentable further limitations on Claim 18 and that Applicant requests not be rejected under 35 U.S.C. 103(a) if Claim 18 is not rejected.

Reconsideration of Claims 9-12, 15 and 18-21 rejected under 35 USC 102(a) as being unpatentable over Rhodes et al (U.S. 4,536,951), Ye et al (U.S. 6,080,529), Huang et al (U.S. 6,180,509, B1) and Liu et al (U.S. 5,693,568) and Pangrie et al (U.S. 6,713,382 B1) is requested based on Amended Claims 9 and 18, and on the above remarks.

Applicants have reviewed the prior art made of record and not relied upon and have discussed their impact on the present invention above.

Allowance of all Claims is requested.

It is requested that should the Examiner not find that the Claims are now Allowable that the Examiner call the undersigned at 989-894-4392 to overcome any problems preventing allowance.

Respectfully submitted,

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